FEDERAL RESERVE BANK
OF SAN FRANCISCO
ECONOMIC REVIEW

MONEY: DEMAND AND CONTROL

FALL 1982

An Examination of the Federal Reserve's Strategy for Controlling the Monetary Aggregates

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I. Introduction

On October 6, 1979, the Federal Reserve changed the way it controlled money from establishing targets for short-term interest rates to focusing on targets for bank reserves. The new procedure was expected to result in more interest rate volatility as the rates were freed to respond to market forces. The procedure was also intended to achieve better control of the monetary aggregates. Since October 1979, interest rate volatility has increased, and monetary control has improved on an annual basis. But surprisingly, the monetary aggregates became *more* volatile on a short-term basis.

In February, 1981, the Federal Reserve published results of a System study evaluating the experience under the new control procedure.[1] The study concluded that the increased volatility of the monetary aggregates in 1980 was caused, in part, by unusually large shocks to the money and credit markets. The largest of these shocks came from the Special Credit Control Program implemented in the Spring of 1980. A second conclusion was that more accurate short-run control might have been achieved by more aggressive adjustments in the reserves targets when the quantity of money departed from target.[2] However, the study also concluded that closer short-run control would most likely entail large increases in interest rate volatility, which could seriously inhibit the performance of the economy.

The present study therefore has two main purposes. The first is to describe how the reserve-oriented monetary control procedure works, in theory and in practice.** The second is to assess the effectiveness of the new procedure as it has been implemented. A key feature of any control procedure is how quickly it brings the quantity of money back to a set target when deviations occur. The evidence in this paper for 1981 through the first half of 1982 suggests that the Federal Reserve has continued to follow procedures producing relatively gradual re-entry to the annual target ranges that form the basis of monetary policy. But unlike the earlier study noted above, this study suggests that deviations could be eliminated more rapidly *without* incurring large increases in interest rate volatility.

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*Research Officer, Federal Reserve Bank of San Francisco. I am indebted to Adrian W. Throop for enlightening discussions of the issues discussed in this paper. Lloyd Dixon provided research assistance.

**This paper was written in the middle of 1982, prior to the reduction in emphasis by the FOMC on M1 targeting and the major deposit regulation that occurred in the latter part of 1982. Thus, the monetary control procedures described and analyzed are those that prevailed in mid-1982.

For a discussion of the issues raised by using M1 as an intermediate target under interest rate deregulation, see John P. Judd and John L. Scadding, "Financial Change and Monetary Targeting in the United States," available from the authors.

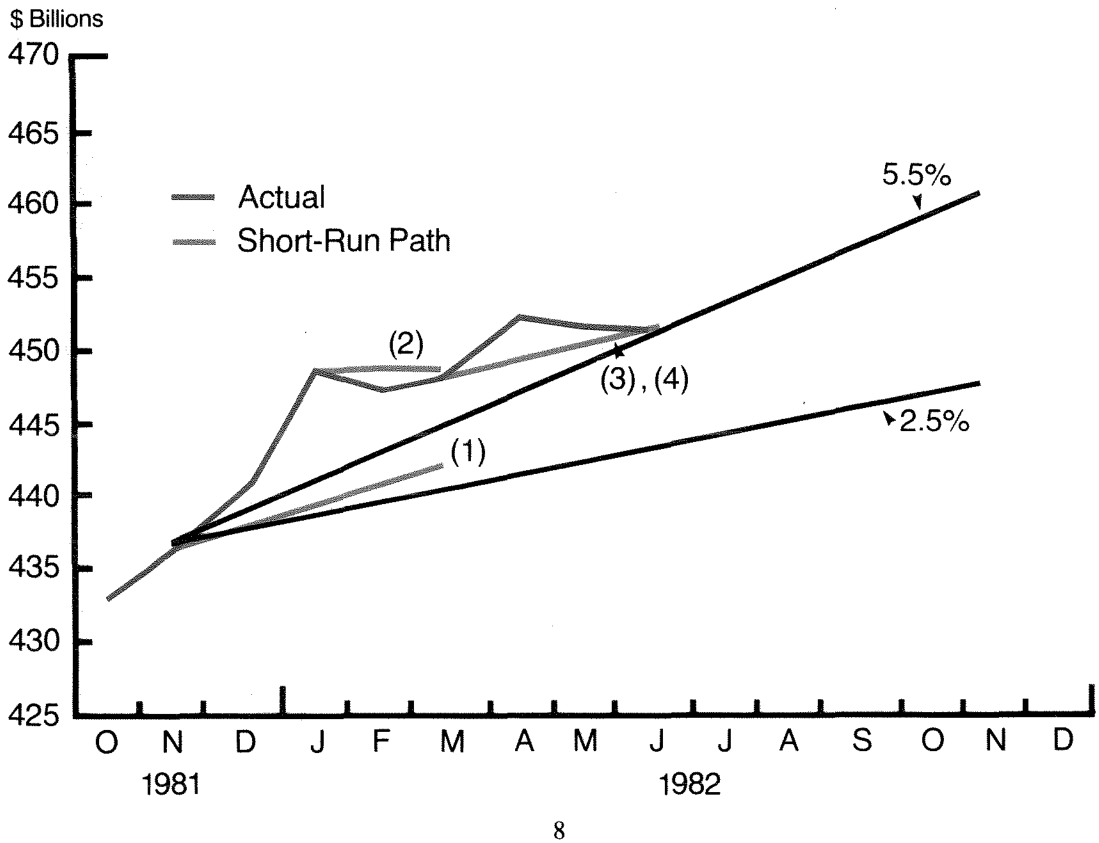
II. Money and Reserve Control Procedures

The Federal Reserve attempts to promote full employment growth at low rates of inflation by maintaining growth rates in certain monetary aggregates that are compatible with its objectives. Each year the Federal Open Market Committee (FOMC) sets *annual growth-rate target ranges* for the monetary (and credit) aggregates. These extend from the fourth quarter of the previous year to the fourth quarter of the current year. In 1982, for example, the range for M1 is 2½ to 5½ percent (see Figure 1).[3] Although ranges are specified for M1, M2, M3 and bank credit, only those for M1 and M2 have had much operational significance since October 1979. These ranges represent the FOMC's goals for average annual money growth. They reflect the long-run policy of gradually lowering the rate of inflation. Over the past three years, the growth rate ranges for M1 have been reduced by about ½ percent each year. The *goal* of this gradualist policy is to reduce growth in money slowly enough over a number of years that inflation is reduced with the smallest possible adverse effects on output and employment.

In recent years, innovations in cash management have made the job of setting appropriate annual growth rates for the aggregates more difficult. These innovations have frequently suggested to policymakers that the public's demand for money is shifting and that growth rate objectives for the aggregates must accommodate these shifts in order to avoid undesired affects on the economy. For example, if the demand for money shifts down and supply is not also lowered, interest rates will fall and monetary policy will have been too expansionary. In 1981, the Fed essentially aimed to keep the quantity of money as measured by M1 near the lower boundary of the target range because the demand for M1 appeared to be shifting downward. By mid-1982, the Fed was content to see M1 at the top of its annual range because of a perceived upward shift in the demand for M1.

Figure 1

Monthly M1—1982



The purpose of this paper is not to evaluate the Federal Reserve's attempts to achieve its macro economic goals, but rather to assess the Fed's procedure for controlling the monetary aggregates in the short-run. Thus, the annual growth rate objectives for M1 are taken as the starting point, without evaluating whether these were the appropriate target ranges for achieving the Fed's macroeconomic goals.

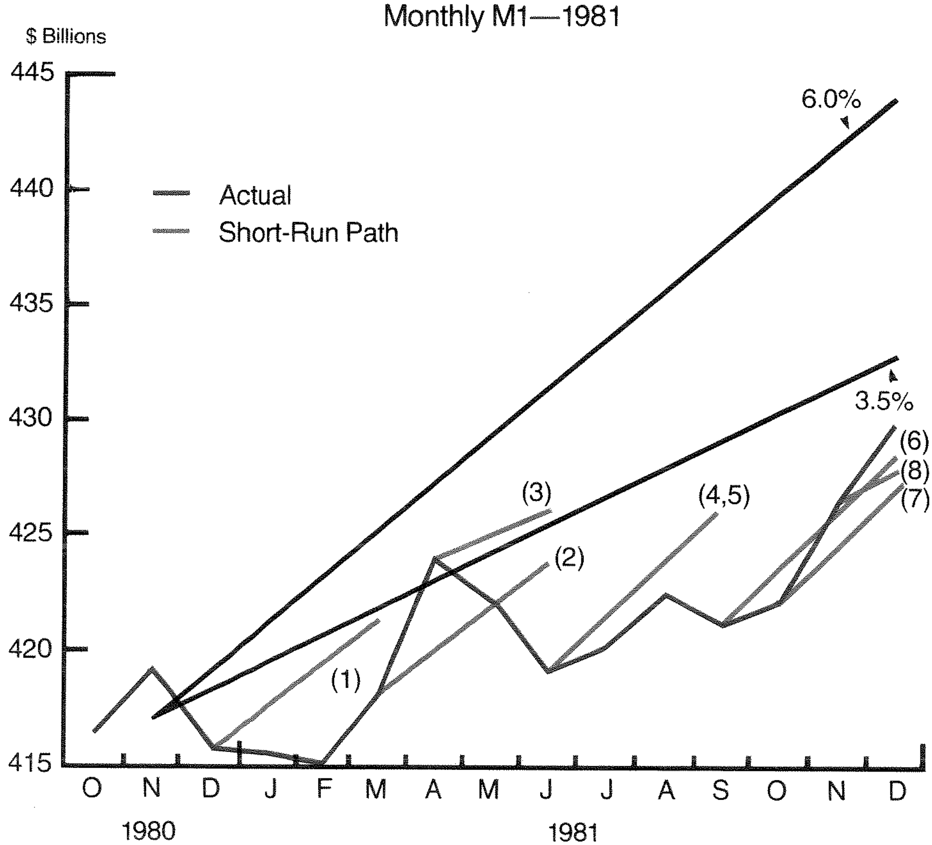
Short-Run Monetary Paths

The Fed's monetary control procedure can be divided into three levels.[4] The first level involves the choice of *short-run paths* for the monetary aggregates (M1 and M2) by the FOMC at each of its meetings. In the final month of each quarter, a three-month path is chosen to cover the next quarter: e.g., on March 31, 1981 a path was chosen for March to June (see line marked (2) in Figure 2). These quarterly paths are sometimes revised in the final two months of the quarter. An example of such a revision occurred on May 18, 1981, when an M1 path for April to June was specified—see the line denoted (3) in Figure 2. This latter path supplanted the original second quarter path.

The short-run paths define the FOMC's preferred rate of re-entry to the longer-run target ranges. For example, again consider the second quarter of 1981. At its March 31 meeting, the Committee chose a growth rate of 5–6 percent for M1, (plotted as 5½ percent in Figure 2 and denoted as (2)) beginning from a March base that was well below the lower boundary of the annual target range. The March path "pointed" M1 back toward its range, and would have achieved the lower boundary of the range within five months (by August) if it had been maintained that long.

Figure 2

Monthly M1—1981



The paths for 1981 and 1982 suggest that the Committee's desired rate of re-entry to the annual range was relatively slow.[5] Each month, the Committee sought to eliminate only a small part of the previous month's deviation of M1 from the annual target range. The shortest re-entry horizon in 1981 was contained in the first quarter path (denoted as (1) in Figure 1), which would have reached the lower boundary of the annual range in early April, about three months after the January deviation just prior to the FOMC meeting in early February. The path denoted 5 would have reached the lower boundary of the annual range in four months, and those denoted 2 and 4 would have reached the lower boundary in 5 months. Finally, paths 6, 7 and 8, chosen for the fourth quarter of 1981 would not have attained the annual lower boundary by the end of that year. Attempted re-entry in the first half of 1982 was somewhat faster. The path denoted 2 in Figure 1 would have achieved the upper boundary of the target range in four months, while the paths denoted as 3 and 4, reach the upper boundary in three and two months, respectively.

The choice of a relatively slow re-entry rate apparently reflects the view that faster re-entry would involve excessive amounts of interest rate volatility. This point was made in the February 1981 Federal Reseve Staff study of the new reserve control procedures. This study concluded that a faster re-entry rate than had been used in 1980 would have provided only marginally closer month-to-month control of M1 at the expense of substantially greater volatility in the Federal funds rate.[6]

Paths for the Reserve Aggregates

The second level of the monetary control procedures translates the short-run paths for M1 and M2 into a path for total reserves over periods between FOMC meetings. These total reserve paths are calculated by multiplying the appropriate reserve requirement ratios by projections of the various reservable liabilities of depository institutions thought to be consistent with the paths for M1 and M2.[7] Since the Fed imposes different reserve requirement ratios on the various components of M1 and M2, and on instruments not in these aggregates, the calculation of the current total reserve paths depends on accurate estimates of movements in the components of M1 and M2 and of other reservable instruments. The Fed must also project reserves held in excess of reserve requirements. These compositional changes require adjustments of the total reserves paths to make them consistent with *unchanged* paths for M1 and M2. These so-called technical, or "multiplier," adjustments are made when necessary on a week-by-week basis. The discussion in the remainder of the paper abstracts from these technical adjustments, and focuses instead on reserve changes designed to be consistent with *changes* in the M1 and M2 paths.

The third level of the control procedure involves the use of a reserves instrument to achieve the short-run paths for M1 and M2. Under certain institutional arrangements, the Federal Reserve has the option of directly manipulating total reserves to control money. However, this approach has not been feasible because of the existing practice of lagged reserve accounting (LRR).[8] This reserve accounting rule requires banks to hold an amount of reserves in any given week based on deposits held two weeks earlier. Banks' required reserves are therefore predetermined in any given week. The Fed, for its part, must supply the banking system with enough reserves to meet the requirement. If the Fed did not do so, it would force some individual banks into a reserve deficiency beyond their control. Thus under LRR, the Fed is not in a position to use total reserves as the money control instrument on a weekly basis.

The Fed's way of dealing with this problem is to use as its control instrument the proportion of total reserves provided to banks through the Federal Reserve discount window. If the Fed wants to pursue a tighter money policy, for example, it supplies fewer reserves outright to the market through open market operations (i.e., fewer non-borrowed reserves). This means that banks will have to acquire a larger proportion of their predetermined required reserves by borrowing at the discount window. Banks, however, are reluctant to go to the discount window because the Fed imposes restrictions on the quantity and frequency of loans it will make to individual banks over specified periods of time.[9] Thus, when the Fed provides fewer non-borrowed reserves, the Federal funds rate must rise relative to the discount rate to induce banks to use up more of their available credit at the discount window. Such increases in the funds rate slow growth in money and total reserves.

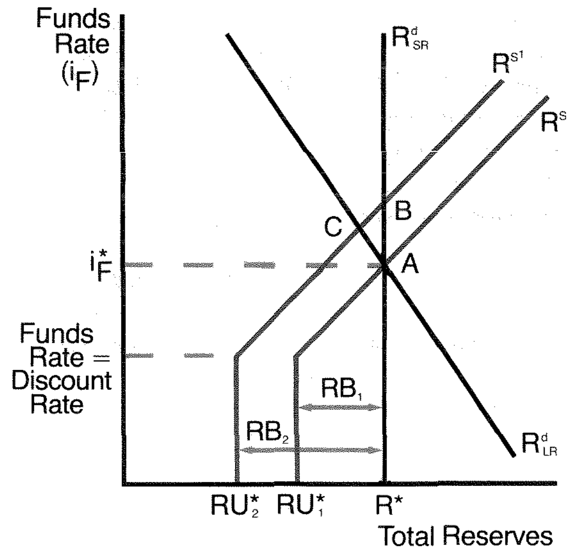
This method of monetary and reserve control is illustrated in Figure 3. Consider first the supply of total reserves, R^S, which consists of two parts. First, so-called nonborrowed reserves (RU) are provided outright to the banking system when the Fed buys open market securities (e.g., Treasury bills) from the public and pays for the securities with bank reserves. Because the Fed directly controls the amount of nonborrowed reserves, this portion of total reserves does not respond to the Federal funds rate, and is depicted by the vertical portion of R^S.

Second, borrowed reserves (RB) are provided when the Fed lends reserves to banks through its discount window. As noted earlier, the quantity of borrowed reserves will rise only if the funds rate increases sufficiently above the discount rate to overcome banks' reluctance to borrow. Thus banks' demand curve of borrowed reserves is upward sloping when the funds rate is above the discount rate. The upward sloping portion of R^S represents the sum of borrowed reserves, which respond positively to the funds rate, plus a fixed amount of nonborrowed reserves. (Note that the kink in R^S occurs where the funds rate equals the discount rate and borrowed reserves are zero. Up to this point, total reserves are composed entirely of nonborrowed reserves, and thus R^S is vertical.)

As noted above, banks' demand for total reserves is predetermined in any given week under LRR. Thus, the short-run demand for reserves, R^D_{SR}, is vertical. However, over periods longer than two weeks, total reserves respond to changes in the quantity of deposits banks issue. Since a higher funds rate restrains deposit growth, the long-run reserves demand, R^D_{LR}, is negatively sloped with respect to the funds rate.

Assume that point A in Figure 3 represents an initial starting point, where total reserves (R^*) and the funds rate (i_F^*) correspond to the level of M1 on its path. Now, suppose the Fed reduces its desired level for M1. This requires a tighter policy in the reserves market, which means a reduction in nonborrowed reserves from RU_1^* to RU_2^*. In the short-run, this action raises borrowings (from RB_1 to RB_2) by an equal amount and raises i_F to point B, because the demand for reserves is fixed. However, the higher funds rate restrains money growth contemporaneously, and this leads, with a two-week lag, to slower growth in the demand by banks for total reserves. Thus, over periods longer than two weeks, the demand for reserves responds to the funds rate and so reserves and the funds rate fall from point B to point C.

Figure 3



If the Fed could predict the supply of and demand for money and reserves with certainty, it could always achieve its desired paths (over periods longer than two weeks) by setting nonborrowed reserves at a level such that R^S intersects the long-run reserves demand curve at the desired level of total reserves. Unfortunately, neither R^d nor R^S is known with certainty. For example, unexpected shifts in banks' reluctance to borrow affect R^S. Unexpected changes in the public's demand for M1 and bank credit affect R^d.

Nevertheless, monetary control procedures affect the extent to which the money supply is affected by these and other shocks. For example, lagged reserve accounting allows money to be pushed away from the target path to a greater extent than does contemporaneous accounting. Under LRR, sudden changes in the public's demand for money affect banks' demand for reserves, and thus the funds rate, with a lag of two weeks. Money is therefore, more susceptible to shocks because the interest rate changes needed to moderate deviations of money from target are delayed. Under contemporaneous reserve accounting (CRR) (where current reserve requirements are determined by current deposits), these moderating interest rate changes occur immediately, contributing to tighter monetary control. The Federal Reserve has recently announced its intention to switch to CRR in 1984.

The operating instrument used for monetary control also has an important effect on the susceptibility of money to shocks. In October 1979, the Fed switched from using the Federal funds rate to using nonborrowed reserves as its instrument of control. The funds rate approach had the disadvantage that unanticipated changes in the demand for money and reserves were often accommodated by automatic increases in the supply of reserves as the Fed held its funds rate instrument constant. This accommodation does not occur to the same extent under present procedures, since the Fed often holds nonborrowed reserves constant when unanticipated changes in money and reserves demand occur. With RU fixed, an increase in money and total reserves demand automatically causes borrowed reserves to rise. Greater borrowing at the window causes the funds rate to rise, which tends to retard the increase in money, leading to a smaller monetary control error. Some analysts argue that a total reserves instrument would be even more effective in this regard, but this remains a matter in dispute.[10] The Federal Reserve's switch to CRR will at least give the System the option of using a total reserves instrument, an option not feasible under LRR.

III. Choosing the Nonborrowed Reserve Path

Another important feature of the monetary control procedure, and the focus of this paper, is how quickly the Fed attempts to reenter the longer run target ranges once deviations occur: i.e. how aggressively does the Fed act to offset monetary control errors? The aggressiveness of monetary control actions can be measured by the size of changes in nonborrowed reserves initiated by the Fed in response to deviations of money and total reserves from path. For example, when money overshoots its path, nonborrowed reserves must be lowered in order to raise the funds rate and eventually make money fall back to its path. All else equal, the larger the reduction in nonborrowed reserves, the more rapidly money will go back to path.

The Fed's method of choosing nonborrowed reserves paths involves two basic elements. The first element is the FOMC's choice of a so-called *initial borrowing assumption*. In addition to choosing paths for M1 and M2, which are translated by the staff into a total reserves path, the FOMC also chooses an initial borrowing "assumption" for the intermeeting period. The total reserves path minus the borrowing assumption is the initial nonborrowed reserves path level to be aimed for by the Federal Reserve Bank of New York Trading Desk. Thus when the FOMC chooses paths for M1 and M2 and an initial borrowing assumption it simultaneously chooses a nonborrowed reserves path.

At each meeting the FOMC is presented by the staff with a menu of (usually) three short-run policy alternatives, typically representing possible "tight," "easy" and "status quo" policies. Each alternative contains a combination of paths for M1 and M2, a borrowing assumption, and a Federal funds rate range.[11] The staff designs each path to be internally consistent, that is, the staff projects that a given level of borrowing would be necessary to achieve the corresponding short-run M1 and M2 paths by the end of the period they cover. Thus by construction, the nonborrowed reserves path (which is calculated on the basis of the initial borrowing assumption) is an initial guess at the level of nonborrowed reserves consistent with achieving the short-run monetary aggregates paths. Since the M1 and M2 paths typically reflect an attempt to re-enter the annual target range gradually, so do the nonborrowed reserve paths.

The second element in the Fed's choice of a nonborrowed reserve path involves intermeeting adjustments of the initial nonborrowed path. Since October 1979, the nonborrowed path has sometimes been changed between FOMC meetings in response to projected deviations of total reserves from path. When total reserves have been projected to be deviating from path during control periods by a significant amount, nonborrowed reserves have sometimes been changed in the opposite direction to speed the movement of M1 back to path. Assume, for example, that total reserves are above path. Holding the path for nonborrowed reserves at its original level would limit the total reserves overshoot to consist of borrowed reserves. Higher borrowing would raise the funds rate and help bring M1 and total reserves back to path. The intermeeting adjustments involve raising borrowing and the funds rate even further, by reducing the nonborrowed reserves path from its original level, thereby inducing M1 and total reserves to move back to path more rapidly.

These intermeeting adjustments were used more frequently in 1980 than in 1981 and their size has varied widely among control periods. In 1980, there were six such adjustments ranging in size from around 25 percent of the total reserve deviation to around 125 percent.[12] In 1981, there were two such adjustments, one that was larger than the total reserve deviation, and a second one that was smaller. Fewer intermeeting adjustments were made in 1981, in part because M1 and M2 often gave conflicting signals—M2 was often above its path when M1 was below its path.

There have also been several control periods in 1980-81 when nonborrowed reserves were changed during intermeeting periods in the *same direction* as total reserve deviations. These actions tended to reinforce total reserve deviations rather than offset them. An example is in April of 1980 (during the period of the Special Credit Controls), when nonborrowed reserves came in below their initial paths in an intermeeting period in which total reserves were well below path. This development reinforced the weakness in M1 and total reserves in that period, but cushioned the declines in interest rates that were occurring simultaneously. Two such reinforcing changes occurred in nonborrowed reserves in intermeeting periods in 1980, and three occurred in 1981.[13]

As shown earlier, the FOMC's choice of initial nonborrowed reserves paths represents relatively gradual rates of re-entry to the longer-run target ranges. However, to evaluate the reserve control procedure as a whole, we must also take account of the adjustments to these initial paths made in the intermeeting periods. These latter actions serve as mid-course corrections in response to the latest data. They do not, however, convert gradual re-entry into rapid re-entry. These mid-course corrections were designed to keep on the pre-determined gradual short-run paths. Moreover, the sporadic use of intermeeting adjustments suggests that they have not been a major factor holding M1 to its short-run paths, especially in 1981.

IV. Rates of Re-Entry

The previous section showed that under current operating procedures the Fed sets its nonborrowed reserves path to be consistent with gradual rates of re-entry of M1 and M2 to the annual target ranges. The major argument advanced for gradual re-entry is that it helps stabilize interest rates. Implicit in this argument is the point that attempts to get back to the annual target ranges more quickly would require larger changes in interest rates. These sharp interest rate changes, in turn, can disrupt financial flows and weaken the performance of the economy.[14]

How aggressively should policy attempt to return M1 and M2 to the annual ranges? This is an empirical question the answer to which depends on several factors. The first issue concerns the size of the response in short-term interest rates elicited by the changes in nonborrowed reserves necessary to achieve given rates of re-entry. The remainder of this section examines this factor. Two other factors will be discussed later: The relative benefits provided to the economy by more stable money market interest rates in the short-run versus less persistent deviations of M1 from target, and the nature of deviations, that is, whether or not they are self correcting.

Conceptual Framework

An analysis of how much increase in interest rate volatility will accompany faster re-entry, in part, depends on empirical estimates of the demand and supply relationships in the markets for money and reserves. We have used the San Francisco money market model to estimate the size of changes in short-term interest rates required for various rates of M1 re-entry to the annual target ranges. The model is a monthly structural model which describes the behavior of banks, the nonbank public, and the Federal Reserve in the markets for bank reserves, deposits and bank loans.[15]

The SF model contains a conventional borrowing function in which banks' demand for borrowed reserves depends positively on the funds rates, and negatively on the discount rate, whenever the funds rate is above the discount rate. Thus the model's supply of total reserves schedule looks like the one shown in Figure 3.

In the model, banks' demand for total reserves varies negatively with respect to the Federal funds rate. Since banks' demand for reserves results primarily from reserve requirements, the reserve demand function reflects the response of deposits to the Federal funds rate. The inverse relationship between the funds rate and deposits depends mainly on two relationships. First, arbitrage in financial markets means that rates on longer-term money market instruments, like commercial paper, tend to move up and down with the federal funds rate. The commercial paper rate represents the interest foregone from holding transactions deposits. For this reason, increases in the paper rate induce the public to hold fewer transactions deposits, and banks consequently need supply fewer of these deposits. This is one way in which a higher funds rate reduces M1 and reserves demand. It is the channel of influence common to most money market models.

Second, bank loans act as a catalyst in another channel of influence unique to the SF model. Banks compete to make loans to the public by setting their loan rates relative to rates available in direct finance markets like those for commercial paper and corporate bonds. For any given level of GNP, the public's demand for bank loans depends negatively on the prime rate and positively on the commercial paper rate. Thus, as the prime rate falls relative to the commercial paper rate, banks issue more loans in response to rising demand by the public. Since the proceeds of these loans are generally paid in the form of transactions deposits, increases in M1 and reserves demand are the immediate effect of loan extensions. These newly created deposits tend to stay in the public's portfolio of assets, and thus affect observed M1, for up to six months, according to the empirical estimates.[16]

Changes in the funds rate affect bank loans and M1 through the prime rate. For example, an increase in the funds rate induces a higher prime rate because banks set their prime rates at a variable markup over their cost of obtaining funds to lend. Since the funds rate forms the base of those borrowing costs, the prime rate tends to move up or down with current and lagged funds rates. Thus, if the Federal Reserve takes actions that raise the funds rate, this raises the prime rate. A higher prime rate causes the supply of money to fall by lowering bank loans.[17]

The presence of bank loan effects means that changes in nonborrowed reserves have a larger effect on M1 and a smaller effect on money market interest rates. An increase in RU, for example, reduces the Federal funds rate and raises M1 in two ways. First, the lower funds rate lowers the commercial paper rate, thereby raising the public's underlying demand for money. Second, higher nonborrowed reserves raise M1 via increases in bank loans, as lower funds rates cause the prime lending rate to fall. This added response of M1 to money market interest rates means that given changes in M1 can be accomplished with smaller changes in interest rates. Bank loan effects therefore have an important implication for monetary control—*the costs of short-run control (interest rate volatility) are less than conventional models (without bank loan effects) would suggest.*

Empirical Results

The money market model was used to estimate the changes in the commercial paper rate needed to eliminate given deviations of M1 from target over different periods of time.[18] The analysis applies to M1 deviations that are persistent, in the sense that they would not be eliminated without Federal Reserve action. The estimates are based on simulations of the estimated model. The model simulations included the assumption that the Fed changes nonborrowed reserves by enough to eliminate specified percentages of initial M1 deviations each month. For example, a four-month control horizon involves eliminating 25 percent of an initial M1 deviation each month for four straight months. Constant nominal income and a constant discount rate were two other assumptions. It should be noted that these simulations were not attempts to replicate a sequence of nonborrowed reserves changes that actually occurred under current procedures. Rather they were designed for comparison purposes to indicate the interest rate consequences of *alternative* rates of re-entry to the annual target ranges.

Table 1 shows the model's estimates of the interest rate consequences of alternative rates of re-entry. The numbers shown are the *cumulative* changes in the commercial paper rate (in basis points) corresponding to the various control horizons also shown. For example, the three-month horizon implies that the RU path is designed to eliminate one-third of a $2 billion M1 deviation each month for three months. RU is then set to hold M1 on path for the next three months. The row labeled three months in Table 1 shows that under such a horizon, a $2 billion M1 overshoot would imply that, in the following six months, the commercial paper rate would be 68, 107, 121, 69, 50 and 45 basis points higher *than it would have been* if there had been no change in nonborrowed reserves.

In general, Table 1 suggests that shorter control horizons (i.e., faster re-entry rates), require larger cumulative changes in the commercial paper rate, and that these larger changes must occur sooner. For example, two-month control requires a 152 basis point change in the paper rate by the second month after the M1 deviation, while three-month control requires a 121 basis point increase in the paper rate by the third month. The most extreme variability would occur with one-month control, which requires a 205 basis point change in the paper rate in the first month following the M1 deviation.

The large difference between the one-month and the two-month control rules has to do with the behavior of bank loans. Empirical evidence indicates that the public's loan demand responds to a change in the prime rate with a lag of one month. This presumably occurs because corporate and other types of borrowing are controlled by spending plans which are not revised very much at the same time that borrowing costs change. In any event, the lag in the response of bank loans to Fed policy actions means that a larger interest rate change is required for a given degree of monetary control.

These results suggest that the change in nonborrowed reserves in response to a deviation of M1 from its annual target range could be larger than it is currently without large increases in interest rate volatility. This finding implies that the Fed could attempt to re-enter the range for M1 within 2 to 3 months, rather than the 4 to 5 month horizon often used, without significantly increasing the volatility of the commercial paper rate.

The preceding analysis assumed that income and prices were unaffected by M1 deviations, but removing this assumption only strengthens the case for closer monetary control. This subject is discussed in the next section.

Table 1
Changes in the Commercial Paper Rate Required to Eliminate $2 Billion M1 Deviations Over Various Horizons

Re-entry Horizon	Months Past M1 Deviation					
	1	2	3	4	5	6
One Month	205	99	61	47	42	47
Two Months	103	152	81	54	45	45
Three Months	68	107	121	69	50	45
Four Months	51	76	92	102	62	50
Five Months	41	61	73	82	91	62
Six Months	34	51	63	71	78	86

Assumes the following initial values: M1 = $450 billion and Commercial Paper Rate = 14 percent.

V. Policy Implications and Conclusions

The Federal Reserve's current approach to reserve targeting involves a relatively gradual re-entry to the annual target ranges once a deviation has occurred. According to the empirical evidence presented in this paper the re-entry rate may be shortened at least a few months without causing significantly larger movements in interest rates.

However, this result *by itself* does not necessarily justify a shortening in the control horizon. The advisability of such a decision depends upon the sources of disturbances to the money and reserve markets that cause the money control errors, and an assessment of the relative costs of interest rate volatility relative to the costs of money control errors.

An argument cautioning against a strong reaction to deviations of total reserves from path is that many deviations are self-correcting. To illustrate, the error term from an estimated money demand equation is relatively large and may account for a large number of temporary M1 and, therefore, total reserves deviations. These deviations correct themselves in a short time without Fed actions that would cause interest rates to change. However, since it is often very difficult to distinguish temporary from permanent disturbances, strong Fed reactions could sometimes unnecessarily induce interest rate volatility.

Nevertheless, by seeking to avoid the error of reacting when it is unnecessary, the Fed runs the risk of not reacting appropriately when disturbances are persistent. It is the latter error that permits M1 deviations to persist long enough to have an undesired effect on GNP and prices. Thus, even if temporary disturbances occurred more frequently than persistent disturbances, it might be worthwhile to choose a faster re-entry rate. In other words, a larger number of unnecessary reactions might be less costly to the economy than a smaller number of large persistent monetary control errors.

Permanent disturbances to the market for money often require very large persistent changes in interest rates to bring M1 back to target. For example, assume that a sudden surge in bank loans causes M1 to accelerate above its targeted path. If this deviation were not corrected quickly enough, GNP would also begin to accelerate. Ultimately, interest rates would have to increase to offset *both* the surge in loans *and* GNP. If the Fed had taken corrective action early, it would only have had to offset the surge in loans. This narrower task requires a smaller and less persistent increase in short-term interest rates.

A problem with persistent swings in short-term interest rates is that they are likely to show up in long-term rates. Investors can choose between buying a long-term security with a maturity equal to their desired investment period, or a series of short-term securities with maturities that add up to the investment period. If the Fed were to offset an M1 control error gradually in an investment period, short-term interest rates would rise gradually in that same period. Investors anticipating the rise, would then prefer to buy short-term securities in series, re-investing each time at the expected higher short-term rates. They would adopt this strategy unless the yield on the long-term security also rose. On the other hand, they would not need this inducement to buy the long-term security if they expected the M1 control error to be offset quickly by a short, sharp increase in short-term interest rates. In this way, gradual re-entry to the M1 paths means more persistent movements in short-term interest rates, which in turn means that longer-term interest rates are affected to a greater degree by monetary control actions. These long-term interest rates are of potentially great importance because they affect business investment and housing.

Finally, deviations of M1 from target can also induce volatility in long-term rates if the deviations are perceived by the public to be persistent enough to affect inflation. A great deal of empirical evidence links higher inflation with faster growth rates for money. Thus, when the public sees a persistent increase in money growth, it may anticipate more inflation. Long-term interest rates then rise because they include a premium for inflation. This relationship between money growth and long-term rates is especially likely to exist when the Treasury runs large budget deficits and when Federal Reserve credibility is low. Faster rates of re-entry to the M1 target can be a more emphatic way of showing that M1 deviations will not persist long enough to affect inflation.

In summary, a more aggressive approach to short-run monetary control most likely would reduce the incidence of persistent M1 deviations that have significant effects on GNP and prices. Such an approach would also reduce the risk that the Fed would be forced to induce persistent swings in short-term interest rates to eliminate large money deviations. Finally, a more aggressive approach might contribute to the stability of long-term interest rates, which are especially important for the performance of the economy.

FOOTNOTES

1. **New Monetary Control Procedures**, Federal Reserve Staff Study—Volumes I and II, Board of Governors of the Federal Reserve System, February 1981.

2. Stephen Axilrod, "Overview of Findings and Evaluation," **New Monetary Control Procedures**, Volume I, pp. A6 and A23.

3. M1 is the sum of currency, traveler's checks, demand deposits, and other checkable deposits. M2 is M1 plus overnight RPs and eurodollars, non-institutional money market funds, and savings and small time deposits. In 1982, M2 was redefined to include retail RPs and to exclude institutional money market funds. M3 is M2 plus large time deposits, term RPs, and institutional money market funds.

4. See E. J. Stevens, "The New Procedure," **Economic Review**, Federal Reserve Bank of Cleveland, Summer 1981, pp. 1–17, for a detailed discussion of the reserve control procedures.

5. In February 1980–November 1980 M1 paths were chosen such that on average, the FOMC sought to eliminate **29.2 percent** of the previous month's error in each current month. Peter A. Tinsley, Peter von zur Muehlen, Warren Trepeta, and Gerhard Fries, "Money Market Impacts of Alternative Operating Procedures," **New Monetary Control Procedures**, Volume II, and Axilrod, February 1981, pp. B1–B4.

6. See Axilrod (1981), p. A17, and Tinsley, von zur Muehlen, Trepeta and Fries (1981).

7. Fred Levin and Paul Meek, "Implementing the New Procedures: The View from the Trading Desk," **New Monetary Control Procedures**, Volume II, pp. A1–A5.

8. See Warren L. Coats. "Lagged Reserve Accounting and the Money Supply Process," **"Journal of Money, Credit and Banking**, May 1976, VIII (1) pp. 167–180: Daniel E. Laufenberg, "Contemporaneous Versus Lagged Reserve Accounting," **Journal of Money, Credit and Banking**, May 1976, VII(1), pp. 239–246.

9. See Murray E. Polakoff and William L. Silber, "Reluctance of Member Bank Borrowing: Additional Evidence," **Journal of Finance**, March 1967, pp. 88–92.

10. David Lindsey, *et. al.*, "Monetary Control Experience Under the New Operating Procedure," **New Monetary Control Procedures**, Federal Reserve Staff Study-Volume 2.

11. The funds rate range has had little operational significance, except occasionally to trigger Committee consultation when the funds rate violates the range.

12. The following equations show how to calculate the difference between the actual value taken on by nonborrowed reserves in a given control period and the initial nonborrowed reserves path implicitly chosen by the FOMC.

(1) $R = RU + RB$

(2) $R^* = RU^* + RB^*$

(3) $RU^* - \overline{RU}^* = + \overline{RB}^* - RB^* + R^* - \bar{R}^*$

where

R = total reserves

RU = nonborrowed reserves

RB = borrowed reserves

* indicates current path

"Bar" * indicates initial path chosen by FOMC.

By subtracting (2) from (1), we obtain

(4) $R - R^* = RU - RU^* + RB - RB^*$.

Next we solve (3) for RB^*, and substitute it into (4), to obtain

$RU - \overline{RU}^* = (R - R^*) - (RB - \overline{RB}^*)$.

Thus, the difference between RU and the FOMC's *initial* path for RU equals the total reserve deviation minus the deviation between borrowed reserves and the FOMC's initial borrowing assumption.

An indication of these values can be obtained from data and description in "Monetary Policy and Open Market Operations in 1980," and "Monetary Policy and Open Market Operations in 1981," **Quarterly Review**, Federal Reserve Bank of New York, Summer 1981 and Summer 1982, respectively.

13. This occurred in the control periods ending 2/6/80, 4/23/80, 2/4/81, 4/1/81, and 12/23/81.

14. Axilrod (1981), p. A17.

15. See John P. Judd and John L. Scadding, "Liability Management, Bank Loans, and Deposit 'Market' Disequilibrium," **Economic Review**, Federal Reserve Bank of San Francisco, Summer, 1981 and "What Do Money Market Models Tell Us About How to Implement Monetary Policy?–Reply," **Journal of Money, Credit and Banking**, November 1982, Part 2, pp. 868–876. Also see Richard G. Anderson and Robert H. Rasche, "What Do Money Market Models Tell Us About How to Conduct Monetary Policy," **Journal of Money, Credit and Banking**, November 1982, Part 2, pp. 796–828.

16. Changes in bank loans have a significant and persistent impact on the monetary aggregates because money is a buffer stock in the public's portfolio. Money acts much like an inventory of goods in a warehouse. Such an inventory, by its very nature, will represent the residual of a whole set of other decisions which, in the short-run could keep the "inventory" from its desired level. The view of money demand as largely passive in the short-run, accommodating

itself to changes in the supply of money, reflects the transactions costs of closely managing money balances. Unanticipated inflows or outflows of funds cause inventories of money balances in the short run to wander away from their desired levels because it is too costly for some money holders to monitor closely their accounts, and to make the necessary purchases and sales of securities frequently enough to bring money balances quickly back to their desired levels.

This view does not dispute the importance of the emergence in the 1970's of sophisticated cash management techniques and new instruments like repurchase agreements. These developments mean that transactions costs are now so low for *some* money holders, especially large corporations, that they hold only money balances that are consistent with their underlying demands. However, smaller and less sophisticated corporations and households could easily hold more or less transactions balances than they desire for an extended period of time. Most households and small corporations have relatively low money balances on average, and actions to adjust those balances to desired levels may be costly relative to the benefits of holding exactly the desired amount of money. If money, therefore, finds its way into these "loosely" managed portfolios, it may stay there for awhile. Moreover, actions of one money-holder to bring balances into line may throw other holders out of balance. For this reason, the system as a whole takes longer to adjust than does any one household or corporation.

Whether these effects are significant enough to make a difference is a factual question. Recent empirical estimates at this bank suggest that buffer stock effects are significant —that the monetary aggregates can depart significantly from levels desired by the public for up to six months at a time; that is, an *increase* in bank loans causes the *level* of money to depart from the public's underlying demand for about six months.

17. The commercial paper rate affects bank loans with a positive sign. This rate also rises with the funds rate. This means that theory cannot tell whether bank loans vary positively or negatively with the funds rate. However, the empirical results in the San Francisco model show an inverse relationship.

18. See Judd and Scadding, 1982 for empirical estimates of the key equations used in the simulations. Other equations in the model can be obtained from the authors.